Sound in the Sea

Objectives

The major objectives of this program are to 1) create a global network for monitoring marine sound of natural and human origin, and 2) determine the effects of this noise on marine mammals and turtles. Listening to underwater sound can reveal objects thousands of miles away. Until now, ocean sound has only been monitored by the military. However, the need to locate earthquakes and whales, the alarming rise of human noise, and the possible harmful effects of noise on animals make it imperative that a civilian network now be created.

Scope

The geographic scope of the sound monitoring network includes the entire northern hemisphere within five years with extension into the southern hemisphere thereafter. The network will enable NOAA to: 1) locate underwater earthquakes, tectonic activity, volcanism and other geological processes, 2) follow the movements of populations of large whales, and 3) measure the rise and spread of human noise that may have negative impacts on animals. The scope of research on these negative impacts includes laboratory and field studies on marine mammals and turtles exposed to explosions, impulses, and continuous sound. The sound program includes components of both Exploration and Research. Many marine sounds are from unknown origins, such that tracing them is a matter of exploration. On the other hand, documenting geological activity, whale populations, and the rise and spread of noise pollution are matters of research. Both are of interest to the general public.

What needs to be done

The NOAA sound network will initially sample the data stream coming from existing monitoring stations maintained by the Navy and Air Force. Later these stations will be supplemented with NOAA monitors in areas that are not covered by existing stations. Calibration trials on ship traffic will be held at selected shallow and deep water sites. As NOAA measures the growth of sound levels into the future it will also trace the historic rise of ocean background noise by analyzing archived Navy data. Finally, NOAA needs to describe normal hearing in many marine species, and to measure the behavioral disruption, masking, and temporary hearing loss that noise causes.

Education/Outreach

The NOAA sound program would begin its work by holding a workshop of academics, environmentalists, military, and other stakeholders in the problem of underwater sound. The workshop would design the network and the research into the effects of noise. The data from the sound monitoring network will be made available on the internet so that the public may experience NOAA exploration and research. This display will include the locations of earthquakes, volcanic activity, and the movements of vocalizing whales in an ocean basin on a yearly basis, as well as samples of the actual sound made by these events, and some sounds of unknown origin.

Scientists/Technology Development and Accessibility

NOAA will partner with the Navy to set up post doctoral fellowships for special advanced training in some aspects of the field of marine noise. The program will develop new

sensors for high frequency sounds that present-day sound monitors do not record. These devices would be moved from site to site where high frequency human noise is being produced, unlike low frequency monitors which remain stationary.

Data and Information Handling

Sampling data from military sources, collecting data from NOAA monitors with dissimilar frequency characteristics, avoiding recording classified sources, funneling the data to one site, compiling it for different uses, and making it broadly available will require sampling and network designs that do not yet exist. The program will develop these capabilities as well as the capacity to handle a large data flow.

Studies/reports

Marine noise is such a newly recognized form of pollution that it has not been included in previous government reports. However, in 1999 noise was one of the top 10 items listed for action in the NOAA constituent's meeting. The problems of human noise, and the need for concerted international action on noise were detailed in "Marine Mammals and Noise" (Richardson et al., 1995; Academic Press, NY). The Natural Resources Defense Council published a white paper entitled, "Sounding the Depths: The Rise of Supertankers, Sonar and Undersea Noise' (NRDC, 1999) which calls for NOAA to perform all of the actions proposed above, as well as other actions.

Five year Budget (thousands)

Item[1]	Year 1	Year 2	Year 3	Year 4	Year 5
Planning/coordination	300	100	100	100	100
Effects of noise on animals	1,000	1,100	1,200	1,300	1,400
Calibration Experiments	2,000	1,500	1,500	1,500	1,500
Integrate Data Streams	700	725	700	725	750
Extend Tao Array	805	980	675	675	675
Extend PIRATA Array	545	225	225	225	225
Occupy existing Atlantic sites	1,225	450	125	125	125
Build & deploy new Pacific sites[2]	1,900	2,500	2,900	3,175	3,200
Build & deploy new Atlantic sites[2]	2,110	2,255	2,855	2,875	3,125
Total	10,040	10,105	10,180	10,950	10,400

[1] Table assumes that NOAA is the sole agency conducting these activities. Actual costs will be lower due to partners sharing costs, but these savings cannot yet be estimated.
[2] Cost is largely ship time for deploying monitors